A revision of the genus *Exserticlava*, with a new species

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The genus *Exserticlava* is reviewed based on the examination of type and authentic specimens, and new collections from Hong Kong. Species in this genus produce thick-walled, distoseptate conidia from polyblastic, funnel-shaped conidiogenous cells borne on mononematous, simple conidiophores. *Exserticlava keniensis* sp. nov. is described. A key to species and a synopsis of their characters are provided.

Key words: aquatic fungi, lignicolous, mitosporic fungi, systematics.

Introduction

Hughes (1978) introduced *Exserticlava* to accommodate *Cordana vasiformis* Matsush. and *C. triseptata* Matsush., two species originally described on wood and bamboo from Japan (Matsushima, 1975). These taxa were later found to be common on wood in tropical streams (Kuthubutheen and Nawawi, 1994; Goh and Hyde, 1997). Two other species, *E. globosa* G.V. Rao and de Hoog and *E. uniseptata* Bhat and B. Sutton were described from India and Ethiopia respectively (Bhat and Sutton 1985; Rao and de Hoog, 1986). *Exserticlava* species produce simple, erect, septate, smooth conidiophores that typically undergo 1-3 percurrent proliferations and bear a single, polyblastic, funnel-shaped conidiogenous cell at the apex. The conidia, which are thick-walled and disto-septate, aggregate around the apex of the conidiophore and secede schizolytically from conidiogenous cells (Hughes, 1978; Kirk, 1985). Disc-shaped scars have been observed on both the conidiogenous cells and the conidia of *E. triseptata* (Kirk, 1985; Nagakiri and Ito, 1995). Matsushima (1985) reported *Chaetosphaeria hiugensis* I. Hino to be the telemorph of *E. triseptata*, but the telemorph is unknown in other *Exserticlava* species.

Species separation in *Exserticlava* is based on the number of conidial septa and shape (Holubová-Jechová, 1990). Conidia of *E. triseptata* and *E. vasiformis* are similar in being 3-septate and ellipsoidal but the conidia are more convex in *E. vasiformis*. In addition, the conidiophores of *E. vasiformis* differ in producing an upward conidiogenous extension. *Exserticlava uniseptata* and *E. globosa* both produce 1-septate conidia, but conidia in *E. globosa* are spherical and slightly verrucose, whereas those in *E. uniseptata* are broadly obovoid and smooth.

Conidiogenesis in *Exserticlava* species is unusual as the outer wall of the conidiophore apex is broken by the initial conidium, leaving a fertile area and collarette developed from the ruptured outer wall. Conidia are produced successively from the fertile conidiogenous loci at the conidiophore apex (Bhat and Sutton, 1985; Nakagiri and Ito, 1995). This is similar to conidial formation in species of *Cacumisporium* Preuss and *Chloridium* Link (Goos, 1969; Cole and Samson, 1979). These genera are considered having sympodulo-phialides (Cole and Samson, 1979), and holoblastic conidia that are formed from the apex of polyblastic conidiogenous cells borne on brown, septate conidiophores. *Cacumisporium*, however, differs from *Exserticlava* as conidia are euseptate and the conidiogenous cells are cylindrical (Tsui *et al*., 2001). The conidia in *Chloridium* are hyaline and aseptate (Gams and Holubová-Jechová, 1976).

During our investigation of lignicolous fungi in freshwater habitats in Hong Kong (Tsui *et al*., 2000), we collected several specimens and species of *Exserticlava*. We reviewed the genus by examining some previously published species from type or authentic material held in IMI and CBS. We have examined a collection of *Exserticlava triseptata* (*sensu* Kirk, 1985) from Kenya. The conidia in this collection were typical of *Exserticlava*, but do not conform to any described species, as the conidia are 3-septate and broadly obovoid. We therefore describe the fungus as *E. keniensis* sp. nov. and now accept five species in the genus *Exserticlava*. A key to species is provided and a synopsis of their morphological characters is given in Table 1.

Taxonomy

Exserticlava S. Hughes, New Zealand Journal of Botany 16: 332 (1978).

Colonies on natural substratum effuse, formed from erect individual conidiophores with a cluster of conidia. *Mycelium* partly immersed and partly superficial, composed of smooth, septate, dark-brown, thin- to thick-walled hyphae. *Conidiophores* macronematous, mononematous, erect, unbranched, straight, cylindrical, with several percurrent proliferations, and a terminal conidiogenous cell. *Conidiogenous cells* integrated, polyblastic, swollen, funnel-shaped. *Conidia* acrogenous, holoblastic, spherical to ellipsoid, 1-3-distoseptate, thick-walled, smooth to verrucose. *Conidial secession* schizolytic.

Key to accepted species of *Exserticlava*

1. Conidiophores with thick-walled, hyaline, subulate apical extension, conidia pale brown to brown, ellipsoid, 29-34 × 17-21 µm, 3-distoseptate .... ***E. vasiformis***
1. Conidiophores not as above 2

2. Conidia 3-distoseptate 3
2. Conidia 1-distoseptate 4

3. Conidia brown, ellipsoid, 28-37 × 14-16 µm .... ***E. triseptata***
3. Conidia pale brown to olivaceous brown, obovoid to broadly obclavate, 23-30 × 19-22 µm .. .. ***E. keniensis***

4. Conidia pale brown, spherical, verrucose, 16-22 × 16-20 µm .... ***E. globosa***
4. Conidia pale brown, broadly obovoid, 15-20 × 11-14 µm .... ***E. uniseptata***

Exserticlava globosa Rao and de Hoog, Studies in Mycology 28: 52 (1986). (Figs. 1–4)

Conidiophores 90-180 × 6-8 µm, with terminal swollen conidiogenous cells *ca*. 10 µm wide. *Conidia* 16-25 × 16-20 µm, spherical, 1-distoseptate, slightly verrucose (Figs. 3-4).

Material examined: CHINA, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood, K.M. Tsui, September 1997, KM 230 [HKU(M) 8051]; INDIA, Karnataka state, Dt. Shimoga, Agumbe, on rotten branches, October 1985, V. Rao [CBS 3855, **holotype**]; *ibid*.. [CBS 3856].

Known distribution: Hong Kong, India.

Notes: We have examined the type material of this species, and the conidiophores were 120-180 × 7-8 µm, which is considerably less than the maximum of 400 µm mentioned in Rao and de Hoog (1986). The material collected in Hong Kong has shorter conidiophores (90-150 × 6-8 µm) than the type.

Exserticlava keniensis K.M. Tsui, Goh and K.D. Hyde, **sp. nov.** (Figs. 5–12)

= *Exserticlava triseptata* (Matsush.) S. Hughes, Mycotaxon 23: 330 (1985).

Etymology: in reference to the type locality, Kenya.

Conidiophora macronemata, mononemata, 170-190 × 7-8 µm, erecta, non ramosa, recta, cylindrica, septata, brunnea. *Cellulae conidiogenae* in conidiophoris incorporatae, polyblasticae, proliferatione sympodice. *Conidia* acrogena, holoblastica, 23-30 × 19-22 µm, obovoidea vel late clavata, 2-3-distoseptata, pallide brunnea vel olivaceus brunnea, conidiorum secessio schizolytica.

Conidiophores macronematous, mononematous, 170-190 × 7-8 µm, erect, unbranched, straight, cylindrical, with a swollen base *ca*. 10 µm wide, terminally swollen, 19-24 µm wide, dark brown, paler towards the apex, with 1-2 percurrent proliferations. *Conidiogenous cells* integrated, polyblastic,

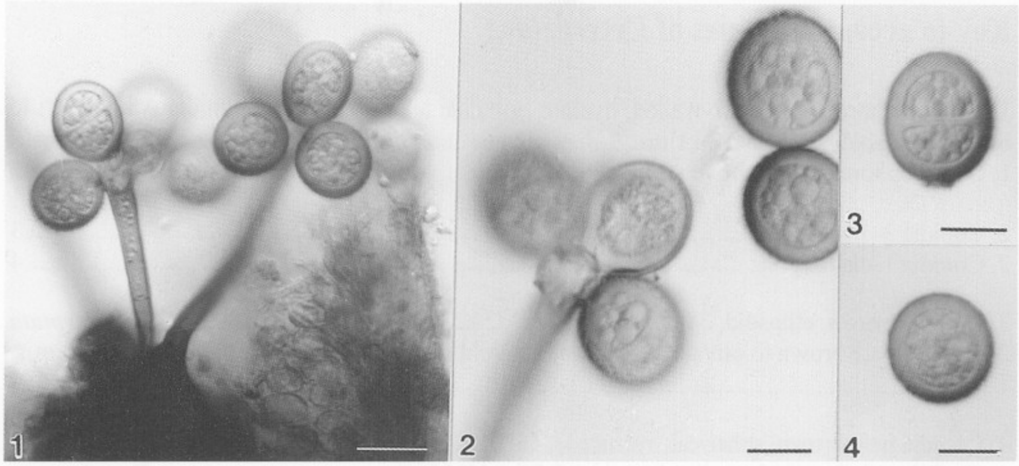


Fig. 1-4. *Exserticlava globosa* (from HKU(M) 8051). **1.** Conidiophores on substrate. **2.** Conidiophores bearing conidia. **3, 4.** Conidia. Bars: 1 = 10 µm, 2-4 = 15 µm.

producing conidia successively. *Conidia* acrogenous, holoblastic, 23-30 × 19-22 µm ($\bar{x}$ = 26 × 20 µm), produced successively from the inner wall of the conidiogenous cells, obovoid to broadly clavate, 2-3-distoseptate, smooth, pale brown to olivaceous brown. *Conidial secession* schizolytic.

Holotype: KENYA, Mt Kenya, Naro Moru track, on stem of *Arundinaria alpina*, 22 January 1984, P.M. Kirk [IMI 284795a, slide].

Known distribution: Kenya.

Notes: The conidia in *E. triseptata* are also 3-septate, but differ in being broadly cylindrical to slightly ellipsoidal compared to *E. keniensis* which has obovoid conidia.

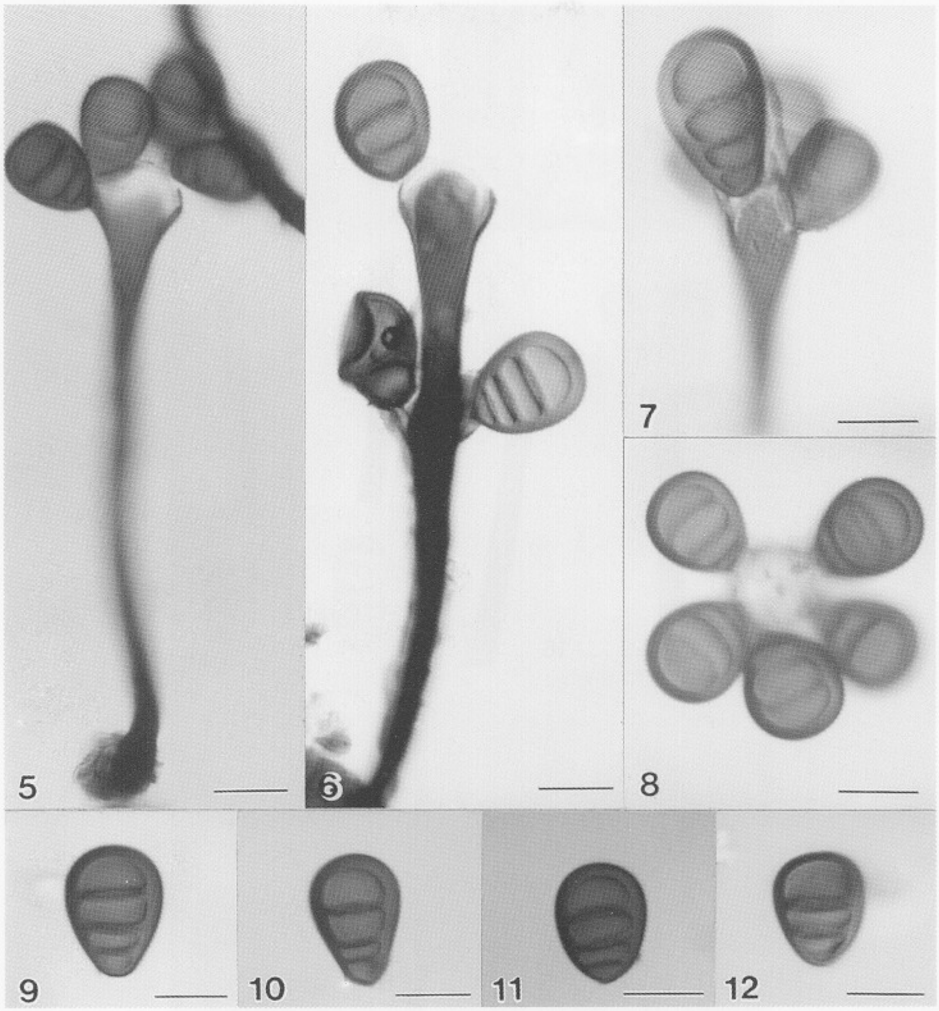
Exserticlava triseptata (Matsush.) S. Hughes, New Zealand Journal of Botany 16: 311 (1978) (Figs. 13–18, 21)

≡ *Cordana triseptata* Matsush., Icones Microfungorum a Matsushima Lectorum: 40 (1975).

Conidiophores 210-260 × 7-8 µm, with a swollen base *ca.* 10 µm wide, terminal conidiogenous cells *ca.* 12 µm wide. *Conidia* 28-37 × 14-16 µm, 3-distoseptate, sometimes slightly constricted at the median septum, smooth (Figs. 17-18, 21).

Material examined: CHINA, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood, April 1997, K.M. Tsui, KM 188 [HKU(M) 5453]; Tsuen Wan, Shing Mun Reservoir, on submerged wood, January 1998, K.M. Tsui, KM 188 [HKU(M) 8194].

Known distribution: Federation states of Micronesia, Ponape (Matsushima, 1985), Hong Kong, Japan (Matsushima, 1975), Malaysia (Kuthubutheen and Nawawi, 1994), Seychelles (Hyde and Goh, 1998).

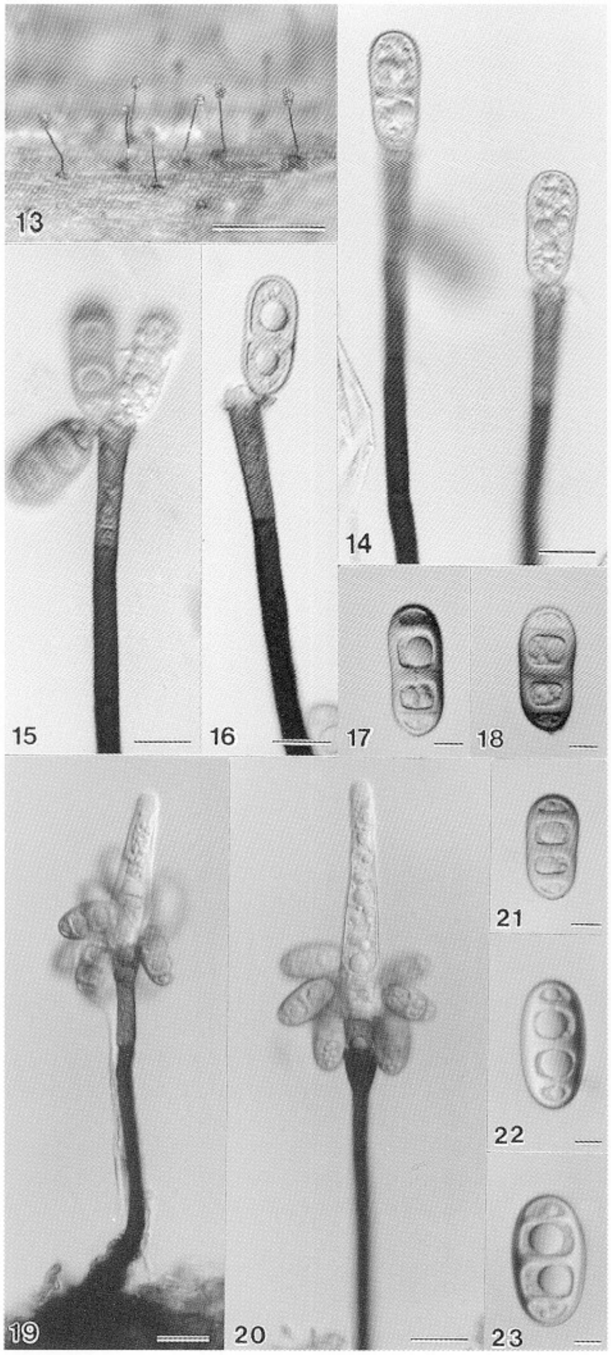


Figs. 5-12. *Exserticlava keniensis* (from holotype). **5, 6.** Conidiophores bearing conidia showing the inverted-flask shaped conidiogenous cells. **7, 8.** Close up of polyblastic conidiogenous cells. **9-12.** Conidia. Bars: 5 = 20 µm, 6-12 = 17 µm.

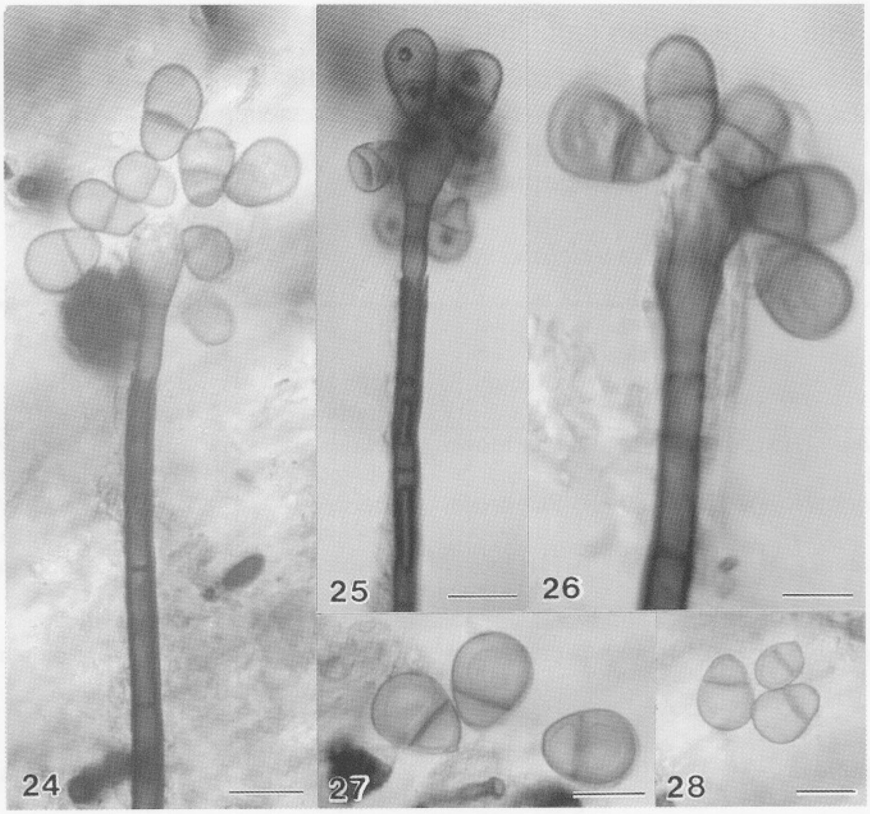
Exserticlava vasiformis (Matsush.) S. Hughes, New Zealand Journal of Botany 16: 311 (1978) (Figs. 19-20, 22-23)

≡ *Cordana vasiformis* Matsush., Icones Microfungorum a Matsushima Lectorum: 40 (1975).

Conidiophores 100-150 × 7-10 µm, up to 18 µm wide at the apex, with a swollen base *ca.*12 µm wide. *Conidiogenous cells* funnel shaped, with an upward subulate, hyaline, thick-walled extension *ca.*100 × 20 µm (Figs. 19, 20). *Conidia* 29-34 × 17-21 µm, broadly ellipsoid, 3-distoseptate (Figs. 22, 23).



Figs. 13-18, 21. *Exserticlava triseptata* (from HKU(M) 8194). **13.** Colonies on natural woody substrate. **14-16.** Conidiophores bearing developing conidia. **17, 18, 21.** Conidia. **19-20, 22-23.** *Exserticlava vasiformis* (from HKU(M) 5370). **19, 20.** Conidiophores bearing conidia and conidiogenous extension. **22, 23.** Conidia. Bars: 13 = 600 µm, 14-16 = 20 µm, 17-18, 21 = 8 µm, 19-20 = 30 µm, 22, 23 = 7 µm.



Figs. 24-28. *Exserticlava uniseptata* (from holotype). **24-26.** Conidiophores showing percurrent proliferation and bearing conidia. **27, 28.** Conidia. Bars: 24 = 18 µm, 25 = 20 µm, 26 = 10 µm, 27-28 = 12 µm.

Material examined: CHINA, Hong Kong, Tai Po, Lam Tsuen River, on submerged wood, September 1996, K.M. Tsui, KM 25 [HKU(M) 4610]; *ibid.* [HKU(M) 4616]; January 1997, K.M. Tsui, KM 25 [HKU(M) 5370]; *ibid.* [HKU(M) 5389]; April 1997, K.M. Tsui, KM 25 [HKU(M) 5469]; *ibid.* [HKU(M) 5473]; December 1998, K.M. Tsui, KM 25 [HKU(M) 12193]; INDIA, Jog falls, on unidentified twigs, October 1985, V. Rao [CBS 3968].

Known distribution: Australia (Goh and Hyde, 1997), Hong Kong, India, Japan (Matsushima, 1975), Malaysia (Kuthubutheen and Nawawi, 1994), New Zealand (Hughes, 1978), North America (Crane and Schoknecht, 1982).

Notes: A frequently observed species with a wide distribution. It is unique in having a subulate, hyaline conidiogenous extension to the conidiophores. The conidia are variable in size but consistently 3-septate.

Exserticlava uniseptata Bhat and B. Sutton, Transactions of the British Mycological Society 85: 116 (1985) (Figs. 24–28)

Conidiophores 180-200 × 6-6.5 µm, with a terminal swelling *ca.*12 µm wide, with 1-3 percurrent proliferations (Figs. 24-26). *Conidia* 15-20 × 11-14 µm, broadly obovoid, 1-distoseptate, septum submedian (Figs. 27-28).

Material examined: ETHIOPIA, Kaffa, Bonga-Felekesalam road, on branch, 24 January 1984, D.J. Bhat [IMI289514, **holotype**].

Known distribution: Ethiopia.

Table 1. Synopsis of *Exserticlava* species.

	Conidio -phores	**Conidia**			
Taxa	**Size (µm)**	**Colour**	**Shape and septation**	**Size (µm)**	**Wall**
E. globosa (Hong Kong)	90-150 × 6-8	Pale brown	Spherical, 1-distoseptate	16-22 × 16-20	Slightly verrucose
E. globosa (type)	120-180 × 7-8	Pale brown	Spherical, 1-distoseptate	21-25 × 18-23	Slightly verrucose
E. keniensis	170-190 × 7-8	Pale brown to olivaceous brown	Obovoid to broadly obclavate, 2-3-distoseptate	23-30 × 19-22	Smooth
E. triseptata	210-260 × 7-8	Pale brown to brown	Ellipsoid with slight constriction at median septum, 3-distoseptate	28-37 × 14-16	Smooth
E. uniseptata	180-200 × 6-6.5	Pale brown	Broadly obovoid, 1-distoseptate	15-20 × 11-14	Smooth
E. vasiformis (Hong Kong)	100-150 × 7-10	Pale brown to brown	Ellipsoid, 3-distoseptate	29-34 × 17-21	Smooth
E. vasiformis (India)	110-170 × 6-8	Pale brown to brown	Ellipsoid, 3-distoseptate	20-26 × 12-14	Smooth

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